Engineering Experiment Station
College of Engineering
The University of Arizona
Tucson, Arizona

NASA CR 70654

TO : National Aeronautics and Space Administration
Washington, D. C. 20546

FROM : Dr. T. L. Vincent, Assistant Professor
Department of Aerospace and Mechanical Engineering

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SUBJECT : Status Report

The main proposed objective for this year's study was to investigate the optimizing conditions to be satisfied at the joining or corner points of sub arc solutions. Significant progress has been made toward this end.

A generalized procedure for handling corners has been developed so that not only the previously known "corner conditions' to be satisfied at a cusp[1], entrance and exist from a fixed boundary[2] and a floating discontinuity[3] may be easily obtained, but, in addition, the results of Mason[3] (now a graduate assistant on the project) have been extended to include discontinuities in time. This latter result allows solutions to be obtained to optimal rocket staging problems with a coasting sub arc in between stages. Examples are now being worked out for this case. In addition, extensions to other types of corners have been investigated and the corresponding optimizing conditions determined. As an example, the interesting case of a "floating" boundary' has been worked out and applied to some elementary geometrical examples. In this case the form of the boundary is a function of the state of the system before entering the boundary. The results of some of these more recent and new investigations will be published in the near future.

While considerable attention has been given to the problems associated with corners, effort has also been directed toward further study of the problems discussed in our previous progress report[4]. One of the extensions of this report has been to use adaptive guidance control to "fly" numerous trajectories and to compare these results to those of the report. As yet however, not enough data is available to make any definite conclusions as to the accuracy and desirability of using this procedure.

One factor which will greatly aid in accelerating future investigations into the applications of the calculus of variations to aerospace problems is the Aerospace and Mechanical Engineering Department's willingness to improve the analog computing facility that we now have available in the department. Just this week a purchase order for a new Applied Dynamics AD-64 analog computer with control logic has been approved.

The expenditures on the contract as of January 15, 1966 have been very light. This was due to the fact that the University did not have a firm commitment that the grant would be given by NASA until mid-October. Since the remaining funds will probably not be exhausted by August 1, 1966, the principle investigator intends to ask for an extension of the performance period of the grant in the near future.

REFERENCES

1. Elsgolc, L. E., "Calculus of Variations," Addison Wesley.

2. Bryson, et al, "Optimal programming problems with inequality constraints I: necessary conditions for extremal solutions," AIAA J., 1, 2544-2550, (1963).

3. Mason, et al, "A Variational Method for Optimal Staging," AIAA J., November 1965.

4. Vincent, et al, "Applications of the Calculus of Variations to Aircraft Performance," NASA progress report, August 1965.